

DEPARTMENT OF GLASS AND SILICATE TECHNOLOGY
AHMADU BELLO UNIVERSITY, ZARIA
M.Sc. GLASS TECHNOLOGY

Introduction

The degree in view is the Master of Science in Glass Technology by course work and thesis. The programme may be undertaken on a part-time for staff in residence or full-time for other candidates. The courses listed in the accompanying sheet are contents of the proposed M.Sc. Glass Technology is the outcome of a painstaking research and broad consultation, which also brings into effect the peculiar needs of the Glass Industries in Nigeria today as well as global trends in the acquisition of knowledge and skill in Glass Technology.

Philosophy

The programme is designed to produce industrial scientists, technologists and engineers with the skills necessary to face the challenges in the areas of materials science teaching, research, consultancy services and industrial management.

Objectives

- (a) To produce glass technologists who can function effectively as academics in any specialization of glass technology and/or silicate science.
- (b) To produce highly efficient professional glass technologists for the glass industry.
- (c) To arm recipients of the course with research skills for proficient operations in research and development in the industry and research institutes in both the public and private sectors of the economy.
- (d) To provide both short and long term training facilities aimed at improving and upgrading the existing and potential high level manpower to meet the development challenges of the national economy plans as well as for improved productivity and performance in the private sector.
- (e) To produce individuals with relevant competences and skills to operate in any glass and glass related fields

Admission Requirements

To be admitted into the programme applicants must hold B.Sc. Glass Technology degree with First or Second Class Honours of Ahmadu Bello University or recognized equivalents. Candidates who hold B.Sc. in Materials Science and Engineering, Chemical Engineering, Geology, Mining Engineering, Industrial Physics, Polymer Science and Technology, Industrial Chemistry, Textile Science and Technology, Metallurgy or Mechanical Engineering may also apply but shall be required to take some core preparatory glass courses.

Graduation Requirements

- 1. The minimum number of course credit units required for graduation is 50
- 2. Each candidate is required to present seminar papers of his/her research during the programme.
- 3. Candidates must submit an approved thesis based on individual research and practical work which will form part of the final assessment.
- 4. In addition to other course assessments, all candidates shall be required to present themselves for oral defense of their thesis as part of the final examination.

**M.SC. YEAR I
FIRST SEMESTER**

CODE	COURSE TITLE	HOURS		LAB	STATUS	CREDIT UNIT
		LECTURE	TUTORIAL/ SUPERVISION			
GTEC 803	General Research Methods	2	1	-	CR	2
GTEC 807	Statistics I	2	1	-	CR	2
GTEC 815	Refractory Materials	2			CR	2
GTEC 821	Furnace Technology	2	1	-	CR	2
GTEC 801	Industrial Raw Materials	2	1	-	CT	2
GTEC 805	ICT in Silicate Technology	2	1	-	CT	2
GTEC 809	Experimental Techniques	2	1	9	CT	4
GTEC 819	Instrumentation and Process Control	2	1	-	CT	2
GTEC 823	Batch Formulation	1	1	9	CT	2
BLDG 813	Business Management	2	1	-	CT	3
GTEC 811	Colour in Glass Technology	2		-	Elective	2
GTEC 813	Quality Control	1		9	Elective	2
GTEC 817	Competitive Materials	2		-	Elective	2
GTEC 881	Seminar 1				CR	1
GTEC 891	Research 1				CR	2
	Total of Core + 4 CU Electives					31

**M.SC. YEAR I
SECOND SEMESTER**

CODE	COURSE TITLE	HOURS		LAB	STATUS	CREDIT UNIT
		LECTURE	TUTORIAL/ SUPERVISION			
GTEC 802	Sintering and Glass melting	2	1	-	CR	2
GTEC 804	Research Methodology	2	1	-	CR	2
GTEC 806	Production Management	2	1	-	CR	2
GTEC 808	Statistics II	2	1		CR	3
GTEC 820	Glass Ceramics	2		-	CT	2
GTEC 822	Strength of Ceramics and Glasses	2		-	CT	2
GTEC 810	Advanced Laboratory Management	2	1	9	Elective	4
GTEC 812	Petrology and Mineralogy for Material Scientists	2			Elective	2
GTEC 814	Polymer Science and Technology	2			Elective	
GTEC 816	Advanced Scientific Glass Blowing	1		9	Elective	2
GTEC 818	Packaging and Environmental Protection	2		-	Elective	2
GTEC 882	Seminar II				CR	1
GTEC 892	Research II				CR	2
	Total of Core + 4 CU electives					26

**M.SC. YEAR II
FIRST SEMESTER**

CODE	COURSE TITLE	HOURS		STUDIO	STATUS	CREDIT UNIT
		LECTURE	TUTORIAL/ SUPERVISION			
GTEC 883	Seminar III	-	-	-	CR	1
GTEC 893	Research III				CR	2
	Unrestricted Elective				Elective	2
	Total					5

**M.SC. YEAR II
SECOND SEMESTER**

GTEC 884	Seminar IV	-	-	-	CR	1
GTEC 894	Research IV				CR	2
	Unrestricted Elective				Elective	2
	Total					5

COURSE DESCRIPTION

GTEC 801: Industrial Raw Materials – 3 Credits

Nature of chemical industries. Raw materials for industries. General classification of industrial raw materials. Glass raw materials. Sand technology. Raw materials for special glasses.

GTEC 802: Sintering and Glass Melting – 3 Credits

What is sintering? Solid-state sintering: stages of solid-state sintering. Transport mechanisms and transport vacancies. Sintering, mechanical properties and abnormal grain growth. Densification. Liquid phase sintering-solution precipitation. Grain and grain boundaries. Reactive liquid phase. Viscous glass sintering: Physico-chemical properties.

GTEC 803: General Research Techniques – 3 Credits

Descriptive versus Inferential Statistics. Data gathering and Analysis. Sample versus Population. Sampling Procedures. Field Sampling. Field Sampling as a non exact science. Laboratory Sampling. Sampling tools.

GTEC 804: Research Methodology – 3 Credits

Research design and methods of conducting field work; choosing appropriate design; investigation techniques; design of instruments; review and writing for learned journals;

writing final reports for thesis and projects; publishing and copyright requirements; preparing paper for seminar.

GTEC 805 ICT in Silicate Technology – 3 Credits

Computer appreciation and system development. What is a computer? Evolution of computers, applications of computers, functional components of computers, classification of computers, advantages and disadvantages of computers. Creation and use of relational database. Accessing of non-classified data on silica and silicate glasses. Use of query tables. Computer prediction of glass properties. Use of computers in glass batch formulation. The use of ready programmed and data dialogue with computer. Use of computer in glass house business, in estimating, scheduling and communication. Computer and materials control. Computer and process control. Computer and report generation. Computer in engineering design and drafting. Others include computer raw materials analyses and data base management. Soft ware, introduction to soft ware programming and programming language.

GTEC 806: Production Management – 3 Credits

Investment analysis production. Factory design. Production control. Factory organization. Work study. Inventory control. Statistical quality control. Job evaluation. Wage incentives. Materials control and management. Production management in the glass and allied industries.

GTEC 807: Statistics I – 3 Credits

Organization and description of data. The meaning of data. Quantitative data and their types. The location of distribution (mode, median, mean, range, mean deviation, variance, and standard deviation. Others are skewness, Kurtosis, standardization, covariance, correlation coefficient and regression equation.

GTEC 808: StatisticsII – 3 Credits.

Introduction to probability, discrete and continuous probability distributions. Introduction to statistical influence and hypothesis testing. Student's t-test, chi-square test, Wilcoxon (T), Man-Whitney U-test, ANOVA (F-test), Kruskal-Wallis (H-test)

GTEC 809: Experimental Techniques – 4 Credits

Crystallography and diffraction Techniques. Molecular and non-molecular solids. Characterization of solids. X-ray diffraction. Bragg's law. Powder method-principles and uses. Electron diffraction. Neutron diffraction. Microscopy techniques-optical microscopy, polarizing microscope, reflected light microscope and applications. Electron Microscopy. Spectroscopic techniques. Vibrational spectroscopy (IR and Raman). Visible and ultraviolet spectroscopy. Electron spin resonance spectroscopy. X-ray spectroscopy. Electron spectrometers. Moss Bauer spectroscopy. Thermal analysis: thermogravimetry differential thermal analysis and differential scanning calorimetry. Applications. Others include electrochemical techniques, analytical spectrometry, atomic spectrometry and molecular spectrometry. Radio chemical methods in analysis, overall analytical procedures and their automations.

GTEC 810: Advanced Laboratory Management – 4 Credits

Principles, practice and ethics in laboratory technology. Laboratory design and management. Good house keeping, experimental design and Safety.

GTEC 811: Colour in Glass Technology – 2 Credits

The origin of colour in inorganic substances. The classification of Glasses according to their chromophores. The colour of glasses produced by various colouring ions. The colours produced by iron, manganese, chromium, vanadium, copper, cobalt, Nickel, Uranium and the Colours produced by the rare earth metals. The colours of glass produced by the non-metallic elements. The colours produced by metal atoms. The fluorescence, thermoluminescence and the solarisation of glass.

GTEC 812: Petrology and Mineralogy for Materials Scientists – 2 Credits

The various physico-chemical processes responsible for differentiation of earth minerals into concentrates of economic importance. Glass making raw materials treated from a mineralogical point of view. Optical method of determination of minerals. Petrological examination of various rocks and minerals. Volcanic eruption (extrusive landform) and natural glasses.

GTEC 813: Quality Control – 2 Credits

Physico-chemical observations and test to ensure the conformity of raw materials and glassware to some standard specifications; these include beneficiation of raw materials, sieve analysis, physic-chemical analysis of the raw materials. Quality of annealing test, internal pressure test, thermal shock resistance tests. Examination of base, side walls and colour of bottles. Density test, verticality test, height test, weight of bottle, external and internal diameter of the various parts of the bottles. Critical, major and minor defects.

GTEC 814: Polymer Science and Technology – 2 Credits

Review of the terms-polymer, resin and plastics. Types of polymers and polymer properties (mechanical, electrical, and barrier properties). Industrial polymers (Thermoplastics Elastomers, Additives) Polymer processing science and technology. Glass-polymer reinforcement and composite materials. Solution properties of polymers. Polymer applications. Dynamism of polymers -past, present and future.

GTEC 815: Refractory Materials – 2 Credits

Classification of refractories. Properties and testing. Manufacture of refractories. Silica refractories. Carbon refractories. Alumino silicate refractories. Magnesite, dolomite, chrome and chrome-magnesite. Special refractories, insulation refractories and silica brick refractories. Furnace technology. Choice of refractories and glass melting.

GTEC 816: Advanced Scientific Glass Blowing – 2 Credits

The Philosophy of creative glass blowing. Advanced study of scientific glasses and the ease of working with different types of glass. Operations with glass-working machine and glass fires. Equipment and tools for a moderate size glass blowing workshop. Printing on glass. Laboratory assembly of complex apparatus.

GTEC 817 Competitive Materials – 2 Credits

Design Materials. Polymers, Alloys, Ceramics etc as complementary in unique applications. Their properties and limitations. Their comparative advantages as basis for development of composites.

GTEC 818: Packaging and Environmental Protection – 2 Credits

General aspects of materials processing, properties and applications, package design, and manufacturing processes related to the glass and allied packaging industries. Pharmaceutical, foods, cosmetics, etc. containers. The Glass packager and the Law. Packaging and environmental protection.

GTEC 819: Instrumentation for Automation and Process Control – 2 Credits

Pyrometry and control temperature scales. Gas thermometers, liquid thermometers, resistance thermometry, thermistors and pyrometric cones (PCE). Chemical tests. Thermocouples, suction pyrometers and radiation pyrometry. Total radiation pyrometer, optical pyrometers and flame temperature. Gas analysis. Fluid flow measurement Control: steps, floating or integral proportionate and derivative controls.

GTEC 820: Glass Ceramics – 2 Credits

Introduction. Definition and history. A new field of technology. The scientific importance of glass-ceramics. Crystallization and diversification. The Glassy state. Nucleation and crystallization of glasses. Nucleating agents and glass types for controlled crystallization. Types of nucleation catalysts. Selection of glass types. The Glass-ceramics process. The preparation of glasses. Conversion of the glass to a microcrystalline ceramic. Special glass – ceramic processes. The properties of glass-ceramics: physical, chemical, mechanical, electrical and thermal properties. Applications of glass-ceramics. The future of glass-ceramics.

GTEC 821: Furnace Technology – 2 Credits

Fuels- classification of fuels, properties and tests. Coal carbonization. Coke, gaseous fuels, liquid fuels, electrical energy and trends in fuel utilization. Furnaces. The evolution of heat, the combustion of fuels and the conversion of electrical energy to heat. Heat transfer, thermal efficiency and furnace aerodynamics. Furnace design and construction. Classification of furnaces.

GTEC 822: Strength of Ceramics and Glasses – 2 Credits

What makes a material brittle? Measurable properties. Strength testing. Weibull statistics. Fracture and fractography. Flaws in brittle materials. Sub-critical crack growth. Strength of silicate glasses. Flaws in ceramics.

GTEC 823: Batch Formulation – 2 Credit

Design of Glass/Glaze compositions. Composites. Ad-hoc formulations and systematic designs. Batch Calculation Methods. Basis of Calculations. Batch Materials handling and storage. Blending Procedures and mixer types.

GTEC 891: Research I– 2 Credits

Thesis Proposal, Preparation and Presentation; This is a formal piece of writing indicating the aim, scope materials and procedures that will be followed in executing a research work.

GTEC 892: Research II – 2 Credits

Field work and thesis preparation in scientific research organized into five chapters; Chapter I focuses on the problem and objectives of the study. Chapter II reviews literature relevant to the study; while chapter III describes the research methodology. Chapter IV deals with the actual research and results. Chapter V summaries the findings, concludes the study and makes recommendations. All these must be done under the supervision of the approved supervisors before both internal and external assessment.

GTEC 892: Research II – 2 Credits

Field work and data collection, thesis preparation - Chapter I focuses on the problem and objectives of the study. Chapter II reviews literature relevant to the study.

GTEC 893: Research III – 2 Credits

Laboratory experiments, Thesis preparation - chapter III describes the research methodology.

GTEC 894: Research VI – 2 Credits

Analysis of results, thesis preparation - Chapter IV deals with the actual research results. Chapter V summaries the findings, concludes the study and makes recommendations.

Ph.D GLASS TECHNOLOGY

Philosophy

The philosophy of the Doctoral programme in Glass Technology is to develop highly skilled, knowledgeable and well rounded intellectuals with the mental and physical competencies to contribute to the progress of a technology driven society.

Admission Requirements

Candidates for Ph.D Glass Technology shall possess a minimum of 4.0 Cumulative Grade Point Average on 5.0 scale or equivalent letter grade B in M.Sc. Glass Technology, M.Sc. Ceramic Technology, M.Sc. Material Science and Engineering or any other recognized equivalent.

Duration of Ph.D programme

The duration will normally be in accordance with the university regulations.

1. For full-time Ph.D programme, the minimum duration is thirty six (36) months and a maximum of sixty (60) months.
2. For part-time Ph.D programme, the minimum duration is sixty (60) months and the maximum normal period is eighty four (84) months.

Graduation Requirements

A Ph.D programme is by course work and research. In addition, candidate admitted into the programme who are adjudged by the Department to be deficient in the area of his/her research interest will be required to take additional stipulated course at the master's level to remedy the deficiencies.

Ph.D Core Courses

The required courses to be taken are four (4) core courses and one (1) elective course depending on the area of specialization. The four core courses are GTEC 901, GTEC 902, GTEC 903, GTEC 904, while the electives are GTEC 905, GTEC 906, GTEC 907.

Course Structure

<u>Course Code</u>	<u>Course Title</u>	<u>Credit Unit</u>
GTEC 901	Advanced Research Methods	3
GTEC 902	Advanced Qualitative Research Methods	3
GTEC 903	Advanced Computer Applications	3
GTEC 904	Advanced Composite Materials	3
GTEC 991-999	Ph.D Dissertation (3cu/semester)	3
GTEC 981-989	Seminar (1cu/semester)	1

Elective Courses

<u>Course Code</u>	<u>Course Title</u>	<u>Credit Unit</u>
GTEC 905	Glasses for Structural Applications	3
GTEC 906	Advanced Competitive Materials	3
GTEC 907	Advanced Scientific Glass Technology	3

Course Synopsis

GTEC 901 Advance Research Methods (3 Credits)

Descriptive versus Inferential Statistics. Data gathering and Analysis. Sample versus Population. Sampling Procedures. Field Sampling. Field Sampling as a non exact science. Laboratory Sampling. Sampling tools.

GTEC 902 Advance Qualitative Research Methods (3 credits)

Research design and methods of conducting field work; choosing appropriate design; investigation techniques; design instruments; review and writing for learned journals;

GTEC 903 Advanced Computer Applications (3 Credits)

GTEC 904 Advanced Composite Materials (3credits)

Cermets, composite materials for aerospace, nuclear, automobiles and construction applications.

GTEC 905 Glasses for Structural Applications (3credits)

Effect of composition on the chemical, thermal and mechanical properties of glasses and their structural applications.

GTEC 906 Advanced Competitive Materials (3 Credits)

Properties and applications of various material types. E.g. Metals, alloys, ceramics, glasses, polymers and composites.

GTEC 907 Advanced Scientific Glass Technology (3 credits)

Applications of Scientific Glass Technology to science and engineering, agriculture, medicine and allied fields. Other titles of Scientific Glass Technology as universal Lathe machine, polariscope and Digital Annealing Lehr.